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Population Estimates of Breeding Blackbirds in North Dakota, 1967, 1981–1982 and 1990

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ABSTRACT.—Red-winged blackbirds (*Agelaius phoeniceus*), yellow-headed blackbirds (*Xanthocephalus xanthocephalus*), and common grackles (*Quiscalus quiscula*) were censused on 129 quarter sections in North Dakota during May 1990. Statewide population estimates of breeding blackbirds in North Dakota were 1,143,000 (SE = 179,000) pairs of red-winged blackbirds, 391,000 (SE = 211,000) pairs of yellow-headed blackbirds, and 768,000 (SE = 188,000) pairs of common grackles. Censuses of the same quarter sections had been made in 1967 and 1981–1982. Red-winged blackbirds declined from 1967 to 1981–1982 and from 1981–1982 to 1990. Number of yellow-headed blackbirds were lower in 1990 than in 1981–1982, but did not differ from 1967. Numbers of common grackles increased from 1967 to 1981–1982, but did not change from 1981–1982 to 1990. Red-winged blackbirds (50%) and yellow-headed blackbirds (99%) were most frequently observed in wetlands. Residences and farmsteads, including associated vegetation, were important to common grackles with 64% observed in this habitat.

INTRODUCTION

Blackbirds are responsible for perennial losses to the sunflower crop in North Dakota. Sunflower is a major crop in North Dakota with over a half million hectares planted in 1990 (National Agricultural Statistics Service, 1991). In a 1990 survey of North Dakota sunflower growers, 16.3% listed bird damage as their worst production problem (Lamey and Luecke, 1991). Red-winged blackbirds, yellow-headed blackbirds and common grackles, which constitute over 10% of the avian abundance in North Dakota (Stewart and Kantrud, 1972), are responsible for most of this damage (Besser, 1985). Data on the distribution and abundance of blackbirds are important for designing cost-effective integrated management programs for controlling sunflower losses by blackbirds (Linz *et al.*, 1988). This study also contributes to the long-term population monitoring goals set by Partners in Flight, an international consortium of public and private organizations concerned with conserving migratory birds (Hunter *et al.*, 1993).

In this study, we estimated the 1990 breeding populations of male red-winged blackbirds, yellow-headed blackbirds and common grackles in North Dakota and compared the results to population estimates obtained in 1967 and 1981–1982 from the same sample units.

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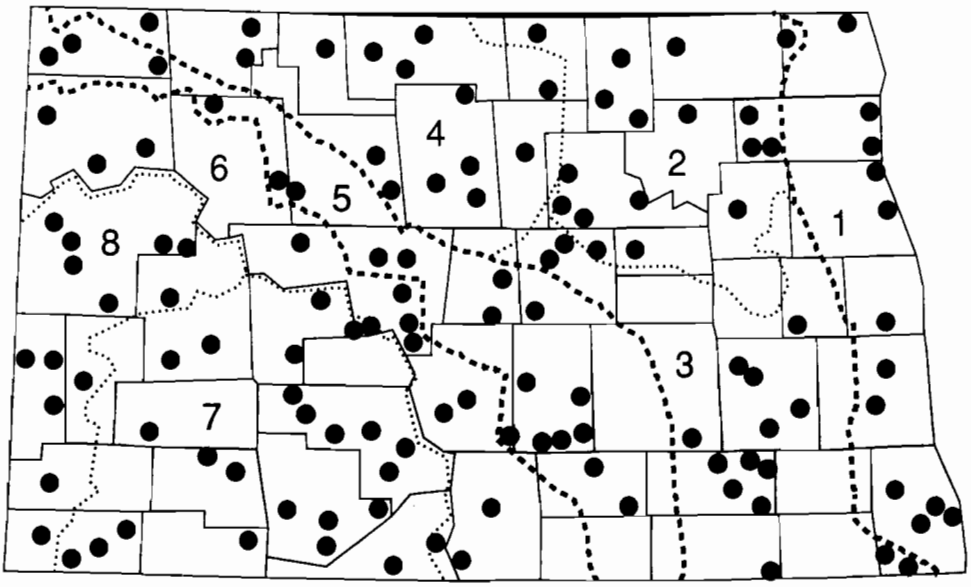

FIG. 1.—Biotic regions of North Dakota and distribution of random quarter section sample units. Dotted lines designate biotic regions as follows: (1) Agassiz Lake Plain; (2) Northeastern Drift Plain; (3) Southern Drift Plain; (4) Northwestern Drift Plain; (5) Missouri Coteau; (6) Coteau Slope; (7) Missouri Slope; (8) Little Missouri Slope (after Stewart and Kantrud, 1972). Dashed lines indicate the four major biotic regions defined by Besser (1985) with 2, 3 and 4 combined to form the Drift Plains and 6, 7 and 8 combined to form the Slopes

METHODS

Sampling.—In 1967, Stewart and Kantrud (1972) estimated the populations of all species of birds breeding in North Dakota using 130 sample units, consisting of one quarter section (64.75 ha) each. They divided the state into eight strata based on biotic characteristics (Fig. 1). Each biotic region was relatively homogeneous over its extent but differed markedly from other biotic regions. Population estimates from a stratified random sampling design yield more precise estimates than simple random sampling if the strata are chosen so that the variation within each stratum is lower than the variation between strata. The number of sample units allocated to each biotic region was proportional to the area of the biotic region. Sample units were then selected randomly and independently for each biotic region. Estimates of the subpopulations inhabiting the biotic regions were combined to form statewide population estimates. Stewart and Kantrud (1972) censused blackbirds on the sample units from 14 May to 10 July.

Breeding blackbird populations in North Dakota were estimated in 1981–1982 by Besser (1985) using the same 130 sample units as Stewart and Kantrud (1972). He censused 122 of the sample units between 28 May and 9 June; the remaining eight were censused between 10 and 24 June. This survey took place over two breeding seasons due to time and labor constraints. In 1981, he surveyed the Missouri Coteau biotic region and the three Drift Plain biotic regions. These four biotic regions contained 72.2% of all blackbirds in the 1967 study. The remaining four biotic regions were surveyed in 1982. He conducted the survey in this manner to minimize the effects of annual variation. Besser pooled Stewart and

Kantrud's (1972) eight biotic regions into four major biotic regions for his analysis (Fig. 1).

The sample units for our study were the same 130 quarter sections surveyed by Stewart and Kantrud (1972) and Besser (1985); however, one quarter section was inadvertently not censused. We censused each sample unit once between 14 May and 1 June 1990. Sample units were surveyed by a team of two walking observers during two daily sampling periods, from a half-hour after sunrise to 1100 and from 1600 to a half-hour before sunset. Each observer censused two adjacent strips 201.2 m wide (each strip was one-fourth of a sample unit) by walking the length of the sample unit (804.7 m) on the centerline of a strip (100.6 m from either edge), then moving to the centerline of the adjacent strip and walking it in the opposite direction. Departures from the centerline of the strips were made when visibility was limited by terrain, shelterbelts, buildings, or other obstacles. Thorough coverage of the entire sample unit was emphasized. Two strips were surveyed concurrently, with a strip separating the two observers. Observers compared notes to prevent double counting flushed birds. These methods follow those of Stewart and Kantrud (1972), except the acceptable sustained wind velocity during censuses was increased from 24 km/h to 48 km/h. Besser and Brady (1984) found no effect of winds up to 56 km/h on the observability of red-winged blackbirds in North Dakota.

All male red-winged blackbirds, yellow-headed blackbirds and common grackles encountered within the quarter section were recorded by species. We assumed that each male blackbird represented a breeding pair, regardless of whether it was detected on a breeding territory or in a nonbreeding situation (*e.g.*, feeding in a field) (Besser, 1985). Because we also assumed that all birds were detected and because red-winged blackbirds and yellow-headed blackbirds are often polygynous, population estimates are considered minimums.

All male blackbirds encountered were recorded by seven habitat types: wetlands, which were areas having standing or flowing water, or typical wetland vegetation [*e.g.*, cattails (*Typha* spp.), bulrushes (*Scirpus* spp.)]; land enrolled in the Conservation Reserve Program (CRP), which is characterized by variable ground cover, consisting primarily of grasses and weeds from 0.2–1.5 m tall; residences and farmsteads (including associated vegetation); shelterbelts (not associated with homesteads) and woodlands; brush and tall weeds (*e.g.*, waste areas, field edges, fence rows, roadsides, and railroad rights-of-way); agricultural uses (fields devoted to pastures and cultivated crops); and other, a group that includes specialized habitats such as a canal construction site and precipitous cliffs. Relative percentages of each habitat type occurring in the 129 quarter sections sampled in 1990 were determined using aerial photographs and on-site inspections. For many fields and most CRP land, the acreages were previously recorded on the aerial photographs by the U.S. Department of Agriculture, Agriculture Stabilization and Conservation Service and were used when available.

Analyses.—Chi-square analyses were used to compare the frequency of occurrence of blackbirds by species on sample units among the 1967, 1981–1982, and 1990 surveys and to compare frequency of occurrence among habitats (Zar, 1984:61–64).

Statewide population totals and variances were estimated by treating Besser's four biotic regions as strata and using Cochran's (1977:89–96) statistical procedures for stratified random samples with proportional allocation. Statewide population totals and variances were also estimated for the two previous studies to eliminate effects of employing different statistical methods, computer software or rounding techniques used in the three studies; thus, results vary slightly from the previously published values for the two prior studies. Reductions in variance due to stratified random sampling, compared to simple random sampling, were estimated using the eight biotic regions delineated by Stewart and Kantrud (1972) as

strata, and also using the four biotic regions employed by Besser (1985) as strata (Cochran, 1977:136–138). This analysis compared the estimated variance of the mean obtained from stratified random sampling to an estimate of the variance of the mean that would have been obtained from a simple random sample.

Counts were not normally distributed and an appropriate transformation was not found; thus, the three surveys were compared by species using the nonparametric Friedman's two-way analysis of variance by ranks (Conover, 1980:299–304). The sample units were treated as blocks since they were the same in each year. Multiple comparisons between years were made using Fisher's least significant difference procedure computed on the ranks at $\alpha = 0.05$ as described by Conover (1980:300, 304).

RESULTS

Frequency of blackbirds on sample units.—Compared to 1967, the proportion of sample units containing blackbirds declined significantly across years ($\chi^2 = 16.8$, 2 df, $P = 0.0001$). At least one individual of one species was found on 82% of the sample units in 1967, 74% in 1981–1982 and only 59% in 1990. The high percentage of sample units with blackbirds in 1967 contributed 39% of the χ^2 and the low percentage in 1990 contributed 59% of the χ^2. The proportion of sample units where blackbirds were observed varied by species. Red-winged blackbirds declined across years ($\chi^2 = 27.6$, 2 df, $P = 0.0001$) from 80% of the sample units in 1967 (57% of the χ^2), to 61% in 1981–1982 and to 49% in 1990 (42% of the χ^2). Yellow-headed blackbirds varied in frequency of occurrence across years ($\chi^2 = 6.5$, 2 df, $P = 0.038$), increasing from 13% in 1967 to 18% in 1981–1982 and decreasing in 1990 to 8%, with the former two each contributing almost 50% of the χ^2. Common grackles also varied across years in frequency of occurrence on the sample units ($\chi^2 = 12.1$, 2 df, $P = 0.002$). Common grackle frequency increased from 25% in 1967 (37% of the χ^2), to 45% in 1981–1982 (60% of the χ^2), then declined to 32% in 1990.

Population estimates.—The 95% confidence intervals of statewide population estimates overlapped between some years for red-winged blackbirds, common grackles and yellow-headed blackbirds (Fig. 2). The statewide total of breeding pairs of blackbirds in 1990 was estimated to be 2,302,000 (SE = 335,000), of which red-winged blackbirds comprised 1,143,000 (SE = 179,000) pairs, common grackles 768,000 (SE = 188,000) pairs, and yellow-headed blackbirds 391,000 (SE = 211,000) pairs.

Red-winged blackbird ($F = 27.49$, 2 df, 257, $P = 0.001$), yellow-headed blackbird ($F = 3.67$, 2 df, 257, $P = 0.027$) and common grackle ($F = 6.83$, 2 df, 257, $P = 0.0013$) populations differed among the years 1967, 1981–1982, and 1990. The nonparametric multiple comparison procedure showed that numbers of red-winged blackbirds had declined from 1967 to 1981–1982 ($P = 0.05$), and from 1981–1982 and 1990 ($P = 0.05$). Yellow-headed blackbird numbers in 1990 were significantly lower than in 1981–1982 ($P = 0.05$), but did not differ from those of 1967 ($P > 0.05$). Common grackles were more abundant in 1981–1982 than in 1967 ($P = 0.05$) but no difference was detectable between 1990 and the two previous surveys ($P > 0.05$).

Stratification.—Stratification, using Stewart and Kantrud's eight biotic regions, was effective in reducing the estimated variance approximately 15%, compared to simple random sampling, for both red-winged blackbirds and common grackles in 1967 and 1981–1982. This stratification did not reduce variance in 1990. Variance for yellow-headed blackbirds was not reduced by the use of this stratification in any survey. Besser's stratification scheme, using four major biotic regions, produced a small reduction (5%) in the variance, compared to simple random sampling, for yellow-headed blackbirds in 1967 and 1990; however, Besser's stratification slightly increased the variance (3%) in 1981–1982. Besser's stratification

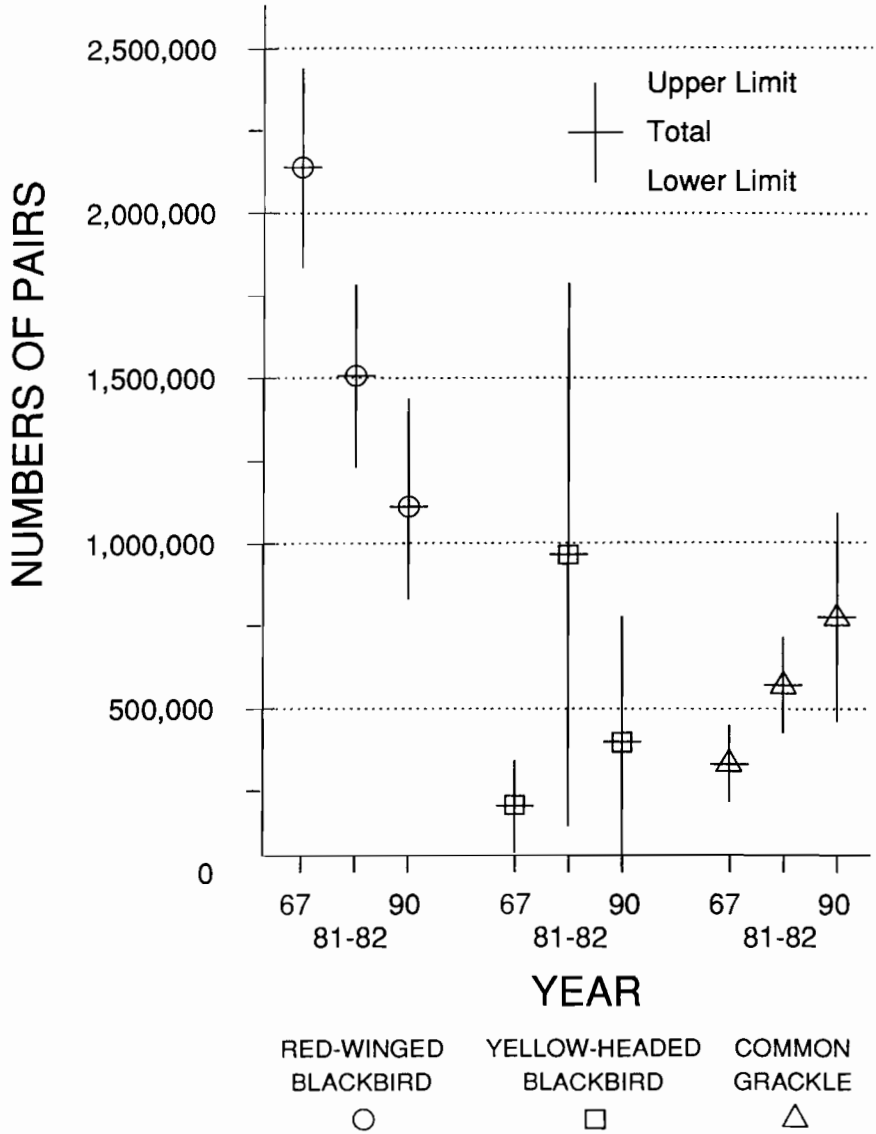

FIG. 2.—Estimated statewide populations and 95% confidence intervals of red-winged blackbirds, yellow-headed blackbirds and common grackles for North Dakota in 1967, 1981–1982 and 1990. Estimates were made using Besser's (1985) stratification of the state by four biotic regions

scheme reduced the variance by approximately 14% and 7%, respectively, for red-winged blackbirds and common grackles in 1967 and 1981–1982. Again, stratification was not effective in 1990.

In 1990, red-winged blackbirds had the highest density in the Missouri Coteau biotic region with 6.22 (SE = 1.92) pairs/quarter section (Table 1). Yellow-headed blackbirds and

TABLE 1.—Mean number (and SE) of pairs of red-winged blackbirds, yellow-headed blackbirds and common grackles, per quarter section by biotic region in North Dakota in 1990

Biotic region	Red-winged blackbird	Yellow-headed blackbird	Common grackle
Lake Agassiz	4.3 (2.2)	0.07 (0.07)	2.0 (1.5)
Drift Plains	4.5 (1.1)	3.6 (2.0)	3.2 (1.1)
Missouri Coteau	6.2 (1.9)	[a]	2.8 (1.4)
Missouri Slopes	2.6 (0.9)	0.04 (0.04)	2.4 (1.3)
North Dakota	4.0 (0.6)	1.4 (0.7)	2.7 (0.7)

[a] No yellow-headed blackbirds were encountered on sample quarters in this biotic region in 1990

common grackles had the greatest densities in the Drift Plains with 3.62 (SE = 1.99) and 3.20 (SE = 1.06) pairs/quarter, respectively.

Habitat use.—Six of the habitat classes from the 129 quarter sections sampled in 1990 were used for chi-square analysis of the frequency of occurrence of blackbirds (Table 2). Because only eight birds were on sites classified as "other," this class was not included in the analysis. The analysis showed that the three species were not encountered in the six habitats with similar frequencies ($\chi^2 = 857$, 10 df, $P < 0.0001$). The prevalence of common grackles around residences contributed 32% of the χ^2. Similarly, the high incidence of yellow-headed blackbirds in wetlands contributed 15% to the χ^2, while the low use of wetlands by common grackles added another 15%.

DISCUSSION

Frequency of occurrence and population estimates.—The frequency of occurrence on sample units showed the same differences among years as population estimates for two species, yellow-headed blackbirds and common grackles. The frequency of occurrence of red-winged blackbirds on the sample units declined from 1967 to 1990; whereas 1981–1982 did not differ from the other two surveys. However, the population estimates declined across years. This trend of declining population size of red-winged blackbirds from 1981–1982 to 1990, without a corresponding decline in frequency of occurrence, may be related to the dry conditions experienced in 1990 and in the preceding 2 yr. Low water conditions probably reduced the productivity of red-winged blackbirds, which frequently nest in wetlands, over

TABLE 2.—Total number and percentage of blackbirds observed in each of six habitat classes and the availability of each habitat class in 1990 on 129 sample units in North Dakota

Species	Habitats						
	Agri-culture	Brush/ Weed	CRP	Resi-dences	Shelter-belts	Wetland	Total[c]
Red-winged blackbird	7%	18%	16%	2%	6%	50%	514
Yellow-headed blackbird	0	0	0	0	1%	99%	184
Common grackle	3%	11%	0	64%	17%	4%	350
Blackbirds[a]	4%	13%	8%	22%	9%	44%	1048
Availability[b]	79%	3%	4%	1%	3%	9%	

[a] Red-winged blackbirds, yellow-headed blackbirds and common grackles combined

[b] One percent of the land area sampled was classified as other

[c] Total number observed

these dry years. The significant decline in both frequency of occurrence and population estimates of yellow-headed blackbirds from 1981–1982 to 1990 was likely due to the dry conditions as well, since yellow-headed blackbirds next exclusively in wetlands (Willson, 1966). The influence of dry conditions on common grackles is unknown.

Stratification.—The two biotic stratification schemes analyzed in this study, Stewart and Kantrud's (1972) eight biotic regions and Besser's (1985) four biotic regions, reduced population variance estimates from those expected from a simple random sampling scheme. Besser's design was less effective for red-winged blackbirds and common grackles; however, it was effective in reducing variance for yellow-headed blackbirds in 1967 and 1990, though not in 1981–1982. The low frequency of occurrence of yellow-headed blackbirds on the sample quarters reduces the reliability of an assessment of stratification effects for this species. Both stratification designs have their merits and drawbacks. Besser's four biotic regions, which are similar to the stratification of North Dakota employed by the North American Breeding Bird Survey (Bystrak, 1981), are simple and convenient to use. A more intensive sampling scheme would have increased the usefulness of stratification in comparing results among surveys.

Habitat use.—Blackbird species did not use habitat in proportion to its availability. Yellow-headed blackbirds were almost exclusively found in wetlands; whereas red-winged blackbirds and common grackles were found in most habitats. However, half the red-winged blackbirds were observed in wetlands and most of the common grackles were located near residences. The predominant land use was agriculture, and relatively few blackbirds were observed in agricultural fields during the breeding season. Because censuses were conducted in the morning and evening, when males spend most of their time maintaining their territories (Besser and Brady, 1984), it is expected that few birds would be detected in habitats without nesting substrate.

The results of habitat use in this study are generally comparable to those of Besser (1985), although we used a simpler classification scheme. The percentage of blackbirds found in wetlands in 1990 decreased 25% from the 1981–1982 study; whereas the percentage of blackbirds in residences and shelterbelts increased 19%. The percentage of sample unit area classified as wetlands decreased from 7.8% in 1981–1982 to 6.1% in 1990. The lower percentage of blackbirds in wetlands in 1990 is also attributable to the drought years of 1988 and 1989, which left many wetlands dry and sparsely vegetated. CRP may provide an alternate breeding habitat to wetlands. In 1990, approximately 3.6% of the sample unit area was in CRP, which did not exist in 1981–1982. CRP land provides suitable nesting cover after a year or two of lying fallow, and 7.9% of the blackbirds were found in this habitat in 1990.

Sunflower producers in North Dakota were faced with increased blackbird depredation pressure from locally breeding birds in 1990 compared to 1981–1982, because much of the sunflower damage is done by blackbirds that breed within 160 km of where the damage occurs (Besser, 1985). Although there was a small decline in the total number of blackbirds in the state, the total amount of sunflower planted decreased from 1.38 million ha in 1982 (McMullen, 1985) to 0.55 million ha in 1990 (National Agricultural Statistics Service, 1991), concentrating the depredation pressure on the fewer remaining fields. Sunflower producers and agencies charged with alleviating the blackbird depredation problem should continue to develop widely applicable techniques to reduce losses.

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LITERATURE CITED

BESSER, J. F. 1985. Changes in breeding blackbird numbers in North Dakota from 1967 to 1981–82. *Prairie Nat.*, **17**:133–142.

——— AND D. J. BRADY. 1984. Censusing breeding red-winged blackbirds in North Dakota. *Wilson Bull.*, **96**:83–90.

BYSTRAK, D. 1981. The North American breeding bird survey. *Stud. Avian Biol.*, **6**:34–41.

COCHRAN, W. G. 1977. Sampling techniques. John Wiley and Sons, New York, N.Y. 428 p.

CONOVER, W. J. 1980. Practical nonparametric statistics. John Wiley and Sons, New York, N.Y. 493 p.

HUNTER, W. C., M. F. CARTER, D. N. PASHLEY AND K. BARKER. 1993. The Partners in Flight prioritization scheme, p. 109–119. *In:* D. M. Finch and P. W. Stangel (eds.). Status and management of neotropical migratory birds; 1992 September 21–25; Estes Park, Colorado. *U.S. For. Serv. Gen. Tech. Rep. RM-229.*

LAMEY, H. A. AND J. L. LUECKE. 1991. Preliminary results of the 1990 North Dakota grower survey of pest problems and pesticide use, p. 27–29. *In:* Proceedings of the Sunflower Research Workshop, Fargo, North Dakota, 10–11 January 1991.

LINZ, G. M., C. E. KNITTLE AND J. L. CUMMINGS. 1988. Estimates of sunflower damage and size of blackbird population in a 308 mi^2 area in Benson and Ramsey counties, North Dakota, p. 2–3. *In:* Proceedings of the Sunflower Research Workshop. Bismarck, North Dakota, 25 January 1988.

MCMULLEN, M. P. 1985. Sunflower production and pest management. Extension Bulletin 25. North Dakota Agricultural Experiment Station and North Dakota Extension Service, North Dakota State University, Fargo. 75 p.

NATIONAL AGRICULTURAL STATISTICAL SERVICE. 1991. Acreage. Washington, D. C. 41 p.

STEWART, R. E. AND H. A. KANTRUD. 1972. Population estimates of breeding birds in North Dakota. *Auk*, **89**:766–789.

WILLSON, M. F. 1966. Breeding ecology of the yellow-headed blackbird. *Ecol. Mongr.*, **36**:51–77.

ZAR, J. H. 1984. Biostatistical analysis. Prentice-Hall, Englewood Cliffs, New Jersey. 718 p.

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